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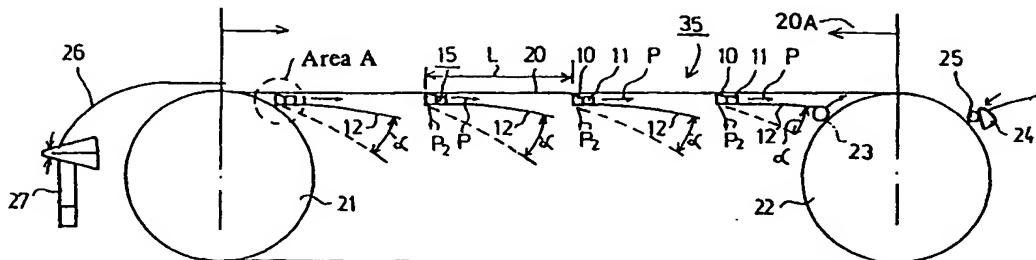
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(71) Applicant: VALMET CORPORATION [FI/FI]; Fabianinkatu 9 A, FIN-00130 Helsinki (FI).		Published <i>With international search report.</i>	
(72) Inventor: AUTIO, Jukka; Paska-Avenue 114, FIN-43500 Kartsula (FI).			
(74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).			

(54) Title: DEVICE FOR CONVEYING AND GUIDING A LEAD-IN STRIP OF A WEB IN A PAPER MACHINE



(57) Abstract

The invention relates to a device for conveying and guiding a lead-in strip in a paper machine, which device comprises a conveyor belt (20) which is permeable to air and in whose connection devices (15) are fitted by whose means a vacuum effect can be produced on the run (20A) of the conveyor belt (20) on which the lead-in strip is conveyed, by means of which vacuum effect the lead-in strip is made to adhere to and kept in contact with said run (20A) of the conveyor belt (20). On said conveying run (20A) of the conveyor belt (20), on the opposite side of the conveyor belt (20) in relation to the lead-in strip, a foil rib/ribs (15) is/are fitted, by whose means said vacuum effect is produced on the conveying run (20A) of the conveyor belt (20).

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Device for conveying and guiding a lead-in strip
of a web in a paper machine

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The invention relates to a device for conveying and guiding a lead-in strip of a web in a paper machine according to the preamble of claim 1.

10 As known in prior art, when a paper machine is started or after a web break, a tail of the web is passed through the paper machine by cutting from the web a narrow lead-in strip, which is guided manually through the machine by using air jets as well as different guide plates and threading devices. Continuously increasing running speeds of paper machines have caused increasing problems in threading of the web
15 and thus new types of arrangements have been needed in order to accomplish threading of the web.

With respect to the prior art relating to the invention, reference is made to *US Patent 3,355,349*, which discloses a belt conveyor intended for transfer of a lead-in strip to
20 a calender or to a reel-up, or a belt conveyor disposed before a calender. This known belt conveyor comprises two reversing rolls and a closed and air pervious belt loop disposed therebetween and having an upper run which is subjected to a vacuum. Said vacuum is produced by means of a suction box which is placed inside the belt loop and which creates a vacuum effect on the upper run of the belt to keep
25 the lead-in strip in contact with the conveyor belt. A drawback in said known device has been that the device which is based on a suction box is rather complex and heavy in structure and it includes a large number of wearing parts and takes much space. This known device lacks the possibility of profiling in a longitudinal direction, and in terms of servicing it is not advantageous. In this arrangement known
30 from prior art, there is a high vacuum on the entire run with the result that there is created heavy friction, and thus large motors are required for conveying the conveyor belt and the web. The purpose of the present invention is to develop further

the above-mentioned conveyor device so that the above-noted drawbacks may be avoided.

With respect to the prior art relating to the invention, reference is also made to *FI Patent 69145*, which discloses a device for conveying and guiding a lead-in strip of a web in a paper machine. This prior-art device comprises a conveyor belt arranged around two or more reversing rolls, which belt is pervious to air and has devices arranged within its loop for producing a vacuum effect on the run of the conveying belt on which the lead-in strip is conveyed, the lead-in strip being caused to adhere to and held in contact with said run of the conveyor belt by means of said vacuum effect. On said conveying run of the conveyor belt, inside its loop, there are provided air blow means which include guide plates extending substantially parallel to the plane of the conveyor belt and the conveying run, in connection with which plates a dynamic vacuum effect can be produced by means of air blowings, said lead-in strip being caused to adhere to and kept in contact with said conveying run of the conveyor belt by means of said vacuum effect. This known arrangement requires an external source of air and a rather large amount of air. This known device suffers from the problem that the air blow means placed one after the other in the running direction of the belt produce a wavelike vacuum curve, which changes from a negative pressure into a positive pressure just before the next air blow means. A problem in this kind of device is that it may cause the web to form bights at the areas with a positive pressure. The purpose of the invention is to develop further this known conveyor device such that the drawbacks described above may be avoided.

The object of the invention is to provide a device for conveying and guiding a lead-in strip of a web, which device does not take much space, which is readily serviceable, which does not require a large amount of air, thereby allowing the amount of air used for producing a vacuum effect to be minimized, and which device can be regulated in a longitudinal direction.

With a view achieving the objectives stated above and those that will come out later, the device for conveying and guiding a lead-in strip according to the invention is mainly characterized in what is stated in the characterizing clause of claim 1.

5 On the conveying run of the conveyor belt in accordance with invention, inside the loop of said run, foil ribs are fitted whose head is in contact with or in the immediate vicinity of the conveyor belt or wire or equivalent, which foil ribs cause a vacuum level to be produced on the outlet face. In connection with the foil ribs, blow nozzles are provided for blowing in the direction of the foil such that a vacuum area is achieved over the distance between two foil heads. The foil head provides a vacuum area without an external source of air as the head guides air away from its outlet side.

In accordance with an advantageous embodiment of the invention, the conveyor belt/band/wire is rotated by an electric motor by means of a cogged belt or by a compressed-air motor from the end of a roll. The advantages of the cogged belt drive include non-slipping acceleration and deceleration, an even driving speed and easy controllability. Air blown through the compressed-air motor or obtained from a separate compressed-air source is passed into foil ribs which are placed under the conveyor belt and by means of which a vacuum can be produced under the wire. The angle of the foil can be regulated, thereby allowing the vacuum level of the foil to be regulated. If a desired vacuum level is not achieved by the action of the foil ribs only, it is possible to utilize the Coanda effect which is provided by means of compressed air or from residual air of the compressed-air motor by blowing said air through a nozzle fitted in connection with the foil rib along the face of the foil rib. The blow nozzle may be divided into two or more sectors in the cross direction in order to regulate the cross direction blow capacity.

In accordance with one advantageous additional feature of the invention, the foil ribs are provided with curved guide faces which further guide the air flow such that the vacuum over the entire length between the foil ribs will remain as desired, and a harmful pressure pulse of positive pressure will not be generated.

The arrangement accomplished by means of a compressed-air motor in accordance with the invention provides its vacuum by itself, and no external source of air is needed. Thus, the consumption of air can be minimized. Controllability is provided by regulating the angle of the foil or the amount of blown air. The distance between 5 the foil ribs is chosen such that a desired vacuum effect can be maintained.

In accordance with one embodiment example, a high vacuum is used in the first foil nozzle, and when the conveyor belt is above the web, a vacuum is also needed for other nozzles. In certain applications, subsequent nozzles are not always needed, for 10 example, in applications in which the transfer distance is not long and the web is situated above the conveyor belt. The vacuum level is regulated by regulating the foil angle or the pressure or the amount of the air blown from the foil and, when needed, a blowing can be provided at the end of the conveyor belt loop before a reversing roll for the purpose of separating the lead-in strip from the conveyor belt.

15 The friction surface in the arrangement in accordance with the invention is almost nonexistent, thereby allowing relatively small motors to be used. Owing to low friction, the wear of the conveyor belt is also minimal, which increases the service life of the conveyor belt.

20 The arrangement in accordance with the invention may be accomplished such that a number of devices in accordance with the invention are placed one after the other forming a conveyor with a module construction for long draws.

25 The arrangement in accordance with the invention is of light construction and easy to service.

30 The invention is suitable for several different places of application in a paper machine, for example, for a press section, a size press, a coater, for a transfer from a dryer section to a calender or for a transfer from a calender to a reel-up. The invention may also be used when the web is passed over open nips, for example, when using the on-line arrangement marketed under the applicant's trademark

OptiLoad, and for a transfer from a dryer section to a reel-up as well as in on-machine coating devices. As is clear from the examples listed above, the device in accordance with the invention is applicable to several different draws in open gaps of a paper machine.

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The invention can be readily combined with various other threading devices, threading plates and threading blowings, etc. known in themselves.

In an advantageous embodiment example of the device in accordance with invention,
10 foil nozzles may also be arranged in the longitudinal direction of the device, in which connection a vacuum in the longitudinal direction can be produced.

In addition, the angle of the foil ribs in accordance with the invention with respect
15 to the running direction of the web can be regulated from a cross direction to a longitudinal direction in order to achieve a desired effect and in order to affect the position of the lead-in strip on the conveyor wire in a lateral direction.

The nozzles used may be slit or hole nozzles.

20 In the following, the invention will be described in more detail with reference to the figures in the accompanying drawing, to the details of which the invention is not by any means intended to be narrowly confined.

Figure 1A is a schematic view of the basic principle of the device in accordance with
25 the invention.

Figure 1B is a schematic view of a vacuum level achieved by means of the arrangement in accordance with the invention as compared with a vacuum level achieved by means of an arrangement known from prior art.

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Figure 2A is a schematic side view of one embodiment example of the invention.

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Figure 2B is a schematic view of the embodiment example shown in Fig. 2A as viewed from above.

Figure 2C is a schematic view of the area A in Fig. 2A.

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Figures 3A and 3B schematically show some advantageous additional features of the device in accordance with the invention.

10 Figure 4 schematically shows one additional application of the device in accordance with the invention.

Figure 5 schematically shows some examples of the use of the invention.

Figure 6 schematically shows some further examples of the use of the invention.

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Figure 7 schematically shows a third application of the invention.

Figure 8 schematically shows pressure as compared with nozzle pressure at different foil angles.

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Figure 9 schematically shows pressure as compared with nozzle pressure at different speeds.

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Figure 10 schematically shows pressure as compared with nozzle pressure when using fabrics having different permeability.

Figure 11 shows pressure profiles across the foil with different permeability values of the conveying fabric.

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Figure 12 shows pressure profiles with different values of the foil angle.

Fig. 1A schematically shows the basic principle of the device in accordance with the invention. Underneath a conveying run 20A of a conveyor belt, wire, band or equivalent 20, foil heads 10 are placed whose apex is in contact with or very close to the bottom face of the conveyor belt 20, and a vacuum is provided on the outlet face of the foil head. The running direction of the belt 20 is denoted with the arrow S in the figure. It is also possible to connect a blow nozzle 11 to the foil heads 10, from which nozzle a blowing P is blown in order to further intensify the effect of vacuum, and thus by the joint action of the foil head and the blowing an air flow F is produced which enhances the vacuum on the outlet side of the foil head. For the purpose of further enhancing the vacuum effect and the air flow, a curved air-flow guide face 12 may be placed after the blow nozzle 11, which guide face further enhances the vacuum effect and guides the air flow. In the figure, the whole of the foil head and the nozzle 11, i.e. a foil rib, is designated by the reference numeral 15. The nozzles 11 may be either slit or hole nozzles.

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Fig. 1B schematically shows the vacuum effect achieved by the foil rib/nozzle combination 15, the dashed line D denoting the point of the apex of the foil head 10 on the conveyor belt 20, and the curve A illustrating the vacuum to be achieved, and the line B of dots and dashes showing the vacuum effect achieved by means of arrangements known from prior art. The horizontal axis C represents the zero level of pressure.

Figs. 2A and 2B show a device 35 in accordance with the invention comprising a conveyor belt loop 20 which is arranged to be rotating around at least two alignment reversing rolls or equivalent 21,22 as an endless closed loop. The conveyor belt 20 is permeable to air. Inside the conveyor belt loop 20, foil ribs 15 are placed which comprise a foil head 10 and a blow nozzle 11 to which a curved air-flow guide face 12 is also advantageously connected. The conveyor belt 20 is preferably rotated by means of a compressed-air motor 30, and air blown through the compressed-air motor is passed into the foil ribs 15 which are placed under the conveyor belt 20 and by means of which a vacuum can be produced under the conveyor belt 20. The angle of the foil can be regulated, whereby the level of vacuum can be regulated. If the

necessary vacuum level is not achieved by regulating the angle, it is possible to utilize the Coanda effect which is provided from residual air of the compressed-air motor 30 or, when an electric motor is used, from a separate compressed air source by blowing air through the nozzle part 11 of the foil rib 15 along the face of the foil.

5 Two blowings can be blown from the nozzle part 11 of the foil rib 15; one on the outlet side producing the Coanda effect, which blowing P preferably follows the curved guide face 12, and the other P_2 on the inlet side in order to enhance the air flow F produced by the preceding foil rib 15.

10 A feed 31 and a flow-through 32 of compressed air as well as by-pass regulating valves 33 are also shown in Fig. 2B. As the figure shows, the compressed-air motor comprises ducts 34 to the foil ribs 15.

15 Fig. 2C schematically shows a partial enlargement of the area A in Fig. 2A showing a suitable shaping of the foil head 10 for the purpose of providing a desired vacuum as one advantageous embodiment example.

In the embodiment example shown in Fig. 2A, a lead-in strip is passed from the preceding stage by means of a threading device 27, to which a guide plate 26 is attached, onto the conveyor 35 of the lead-in strip in accordance with the invention, from the conveyor belt 20 of which conveyor the lead-in strip is separated by a blowing which is produced by a blow nozzle 23, and passed further by means of a blowing produced by a blow device 25 onto a guide plate 24 of the lead-in strip.

20 The distance L between the foil ribs 15 used in the device 35 in accordance with the invention is 30 to 1000 mm, preferably 50 to 200 mm, the foil angle is below 10°, preferably below 3°, and the air permeability of the conveyor belt 20 is below 10,000 m³/m²*h. The amounts of air used with a belt 20 of the width of 200 mm are about 50 to 300 l/min, typically less than 400 l/min, i.e. about 2,000 l/min/width metre, and pressures are used to pressures of up to about 2 bar. The regulation angle α of the foil is 1 to 10°, preferably 1 to 5°. The radius of curvature of the guide plates 12 is 300 to 1000 mm, preferably 400 to 600 mm.

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In the embodiment example shown in Figs. 3A and 3B, a nozzle 17 extending in the longitudinal direction of the conveyor belt 20 is attached to the device 35 in accordance with the invention, from which nozzle blowings P17 are blown, in which connection a longitudinal vacuum effect is achieved which can be enhanced by
5 means of curved guide plates 18. As Fig. 3A shows, the foil ribs 15 can be turned from a cross direction to an oblique position and to a longitudinal position, i.e. as far as the running direction of the belt as desired in order to produce a vacuum effect of a desired type.

10 Fig. 4 shows that blowings P₂₀ can be directed from the foil rib 15 such that the lead-in strip can be displaced in a lateral direction on the belt 20.

Figs. 5 to 7 schematically show some areas of application where the device 35 in accordance with the invention may be used in conveyance and guidance of a lead-in
15 strip. The direction of running of the lead-in strip is designated by the reference numeral S and the same reference numerals are used of corresponding parts.

In Fig. 5, the lead-in strip is passed from the last drying cylinder 51 of a dryer section 50 to a calender 60 first over a guide roll 52 to a device 35₁ in accordance
20 with the invention. The device 35₁ of the invention placed in connection with the guide roll 52 can be turned such that the lead-in strip can be arranged either to run through all calendering nips N₁—N_N of the calender 60 or such that the lead-in strip passes only through the lowermost nip N_N of the calender 60. When the lead-in strip is passed such that calendering is performed in all the nips N₁—N_N, the lead-in strip
25 is passed by means of a second device 35₂ in accordance with the invention onto a guide roll 53, and therefrom further by means of a third device 35₃ in accordance with the invention into a first calendering nip N₁ of the calender 60. After that, the lead-in strip of the paper web is passed to a reel-up after the last nip N_N of the calender, first using a device 35₄ in accordance with the invention onto a guide roll
30 61, therefrom via a device 35₅ in accordance with the invention onto the following guide roll 62 and further using a device 35₆ in accordance with the invention via a measurement device 73 and a guide roll 74 to the reel-up 70 by means of two

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devices $35_7, 35_8$ of the invention placed underneath. A movable air blow plate 77 is placed after the measurement device 73 for conveying the lead-in strip, in connection with which plate a pneumatic cylinder 77a is provided for displacing the plate 77 in the machine direction. As the figure shows, the devices $35_1 \dots 35_8$ in accordance with the invention can be placed above or under the lead-in strip and provided with movable air blow plates at scanners, through passages, etc.

Fig. 6 schematically shows an embodiment example in which a lead-in strip is passed from the last drying cylinder 51 of a dryer section 50 directly through measurement devices 81, 73 to a reel-up 70. As Fig. 6 shows, devices 35 in accordance with the invention are placed in all suitable open draws over which the lead-in strip is passed. The devices in accordance with the invention are numbered consecutively using a subscript $35_1 \dots 35_6$. Guide rolls are designated by the reference numerals 52, 82, 83, 74.

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Fig. 7 shows an embodiment example in which devices 35_1 in accordance with the invention are used in a draw between a dryer section 70 and a measurement frame 95. The lead-in strip is passed to a size press 90 and to an after-dryer section 79 by rope threading.

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Fig. 8 schematically shows pressures as compared with the nozzle pressure at different foil angle values. The vertical axis shows the pressure in pascal (Pa) and the horizontal axis shows the nozzle pressure in bar (bar). The curve 101 represents the situation when the foil angle is $0^\circ +$, the curve 102 represents the situation when the foil angle is 2° , and the curve 103 represents the situation when the foil angle is 4° . The air permeability of the conveyor belt in this test was $8,000 \text{ m}^3/\text{m}^2/\text{h}$ and the speed $1,800 \text{ m/min}$. The curves 101, 102, 103 intersect the nozzle pressure at a value of about 0.22 bar, after which the highest vacuums were achieved at a foil angle of $0^\circ +$. The expression $0^\circ +$ used above means that the angle is very close to zero, yet not negative.

Fig. 9 shows pressures as compared with the nozzle pressure at different speeds when the air permeability of the conveyor belt is $8,000 \text{ m}^3/\text{m}^2/\text{h}$ and the foil angle 2° . The vertical axis shows the pressure in pascal (Pa) and the horizontal axis shows the nozzle pressure in bar (bar). The curve 104 represents the situation when the speed is 2,300 m/min, the curve 105 represents the situation when the speed is 2,000 m/min, the curve 106 represents the situation when the speed is 1,800 m/min, the curve 107 represents the situation when the speed is 1,500 m/min, and the curve 108 represents the situation when the speed is 1,000 m/min. As the curves of Fig. 9 show, increasing speed enhances the vacuum effect without the feed pressure of air being changed.

Fig. 10 shows pressures as compared with the nozzle pressure with different air permeability values of the conveyor belt, while the foil angle is 2° and the speed used is 1,800 m/min. The vertical axis shows the pressure in pascal (Pa) and the horizontal axis shows the nozzle pressure in bars. The curve 109 represents the situation with an air permeability of the conveyor belt of $10,000 \text{ m}^3/\text{m}^2/\text{h}$, the curve 110 with an air permeability of $8,000 \text{ m}^3/\text{m}^2/\text{h}$, and the curve 111 with an air permeability of $5,000 \text{ m}^3/\text{m}^2/\text{h}$. In other words, by increasing the air permeability of the conveyor belt, the vacuum effect can be enhanced.

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Fig. 11 shows pressure profiles across the foil with different air permeability values of the conveyor belt. The test was carried out while the speed was 1,800 m/min, the foil angle was 2° , and the nozzle pressure was 1 bar. The curve 112 represents the situation with an air permeability value of $5,000 \text{ m}^3/\text{m}^2/\text{h}$, the curve 113 with an air permeability value of $8,000 \text{ m}^3/\text{m}^2/\text{h}$, and the curve 114 with an air permeability value of $10,000 \text{ m}^3/\text{m}^2/\text{h}$. The reference arrow 115 denotes the apex of the foil and the reference arrow 116 denotes the rear edge of the foil. During the test, the apex of the foil was in contact with the lower face of the conveyor belt. The vertical axis shows the pressure in pascal (Pa) and the horizontal axis shows the distance from the foil in millimetres (mm).

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Fig. 12 shows pressure profiles at different foil angles. The curve 117 represents the situation when the foil angle is 4° , the curve 118 represents the situation when the foil angle is 2° , and the curve 119 represents the situation when the foil angle is 0° .
5 The reference arrow 120 denotes the apex of the foil and the reference arrow 121 denotes the rear edge of the foil. The vertical axis shows the pressure in pascal (Pa) and the horizontal axis shows the distance from the foil in millimetres (mm).

It is seen from Figs. 11 and 12 that by means of the arrangement in accordance with
the invention it is possible to create short machine-direction vacuum zones which can
10 be regulated. The vacuum effect holding the belt is achieved immediately after the
belt arrives at said vacuum zone.

Above, the invention has been described only with reference to some of its advan-
tageous embodiment examples, to the details of which the invention is, however, not
15 by any means intended to be narrowly confined. Many modifications and variations
are feasible within the inventive idea defined in the following claims.

Claims

1. A device for conveying and guiding a lead-in strip in a paper machine, which device comprises a conveyor belt (20) or equivalent which is permeable to air and
5 in whose connection at least one means (15) is fitted in order to produce a vacuum, by means of which means (15) a vacuum effect is produced on the run (20A) of said conveyor belt (20) on which the lead-in strip is conveyed, by means of which vacuum effect the lead-in strip is caused to adhere to and kept in contact with said run (20A) of said conveyor belt (20), **characterized in that the means for producing**
10 **a vacuum on the run (20A) of the conveyor belt (20) or equivalent conveying the lead-in strip is a foil rib (15), which is fitted on said run (20A) of said conveyor belt (20) or equivalent conveying the lead-in strip, on the side opposite to said lead-in strip, and that the foil rib (15) includes a foil head (10) by means of which a vacuum is arranged to be provided on the outlet side of the foil head (10).**
- 15 2. A device as claimed in claim 1, **characterized in that the foil head (10) is placed under the conveying run (20A) of the conveyor belt or equivalent (20), and that the foil head (10) is in contact with or very close to the bottom face of said conveyor belt (20).**
- 20 3. A device as claimed in claim 1 and/or 2, **characterized in that the foil rib (15) further comprises a blow nozzle (11) by means of which a blowing (P) is produced in the direction of the foil for the purpose of further enhancing the vacuum effect.**
- 25 4. A device as claimed in any one of the preceding claims, **characterized in that a curved guide face (12) is fitted in connection with the foil rib (15), which guide face is arranged to guide an air flow (F) provided by means of the foil head (10) and the blow nozzle (11) for the purpose of further enhancing the vacuum effect by means of the Coanda effect.**

5. A device as claimed in any one of the preceding claims, characterized in that the foil angle of the foil head (10) is fixed or adjustable in order to achieve a desired vacuum effect.
- 5 6. A device as claimed in any one of the preceding claims, characterized in that the blow nozzle (11) is divided into two or more sectors in a cross direction in order to regulate the blow capacity in a cross direction.
- 10 7. A device as claimed in any one of the preceding claims, characterized in that the angular position (α) of the foil rib (15) with respect to the conveyor belt can be regulated in order to produce a desired vacuum effect.
- 15 8. A device as claimed in any one of the preceding claims, characterized in that the foil ribs (15) can be turned to a desired angular position between a transverse position and a longitudinal position in relation to the running direction (S) of the conveyor belt (20).
- 20 9. A device as claimed in any one of the preceding claims, characterized in that a longitudinal foil rib (17) is arranged in connection with the foil ribs (15) in order to produce a longitudinal vacuum effect.
10. A device as claimed in any one of the preceding claims, characterized in that on the conveying run (20A) of the conveyor belt (20) there are several foil ribs (15) spaced from one another.
- 25 11. A device as claimed in claim 10, characterized in that the distance between the foil ribs (15) is 50 to 1000 mm, preferably 100 to 300 mm.
- 30 12. A device as claimed in any one of the preceding claims, characterized in that the conveyor belt (20) is arranged to be an endless loop which is disposed around two or more reversing rolls (21,22) and inside which loop said foil ribs (15) are fitted.

13. A device as claimed in any one of the preceding claims, characterized in that a compressed-air motor (30) is fitted in connection with the conveyor belt (20) in order to move the conveyor belt (20) around the reversing rolls (21,22), and the air (32) blown through said compressed-air motor (30) can be passed into the foil ribs 5 (15) placed inside the conveyor belt (20).

14. A device as claimed in any one of the preceding claims, characterized in that air obtained from the residual air of the compressed-air motor is arranged to be used in the blow nozzles (11) of the foil ribs (15).

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15. A device as claimed in any one of the preceding claims, characterized in that an electric motor and a frequency converter are arranged in connection with the conveyor belt (20) in order to drive the conveyor belt (20).

15

16. A device as claimed in claim 15, characterized in that an air blow duct of the foil rib (15) is connected to a separate compressed-air source.

17. A device as claimed in claim 15, characterized in that the conveyor belt (20) is arranged to be driven by means of a cogged belt.

20

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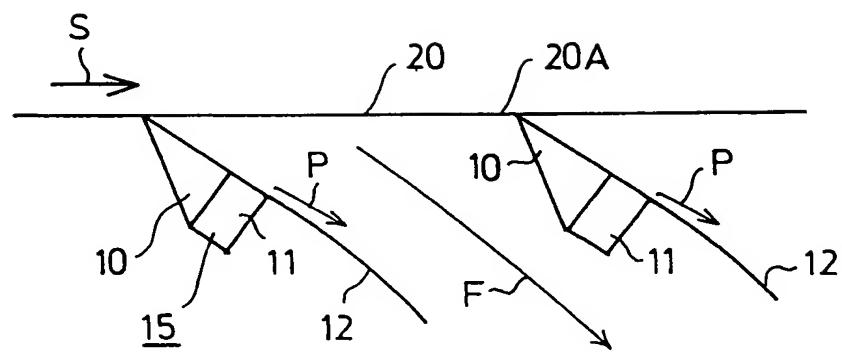


FIG. 1 A

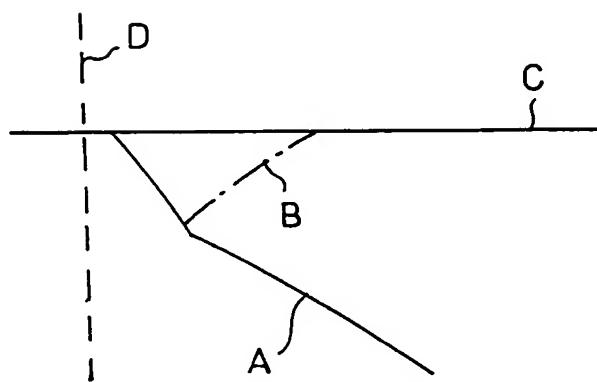


FIG. 1 B

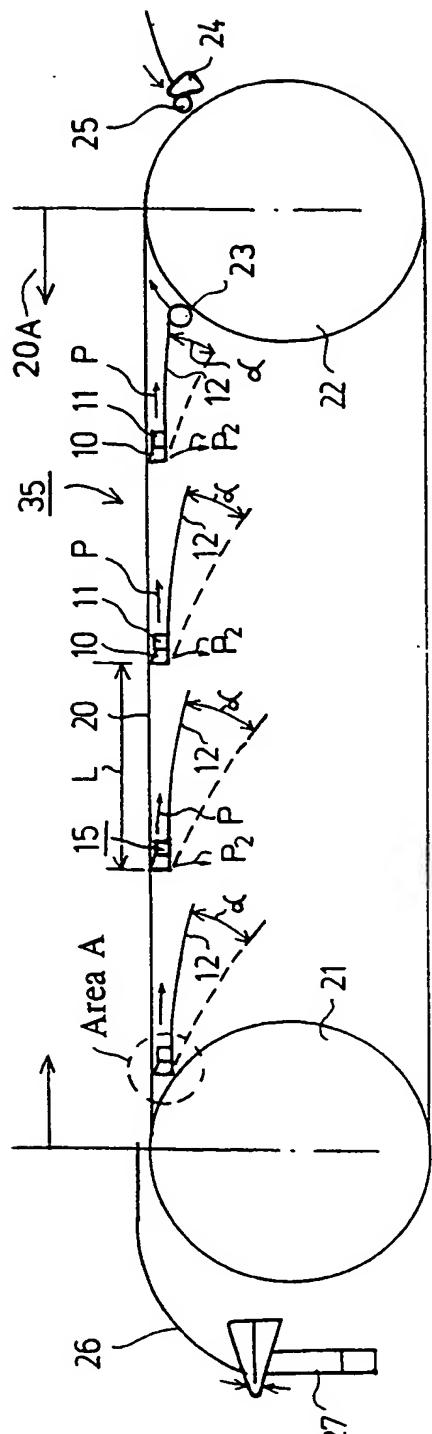


FIG. 2A

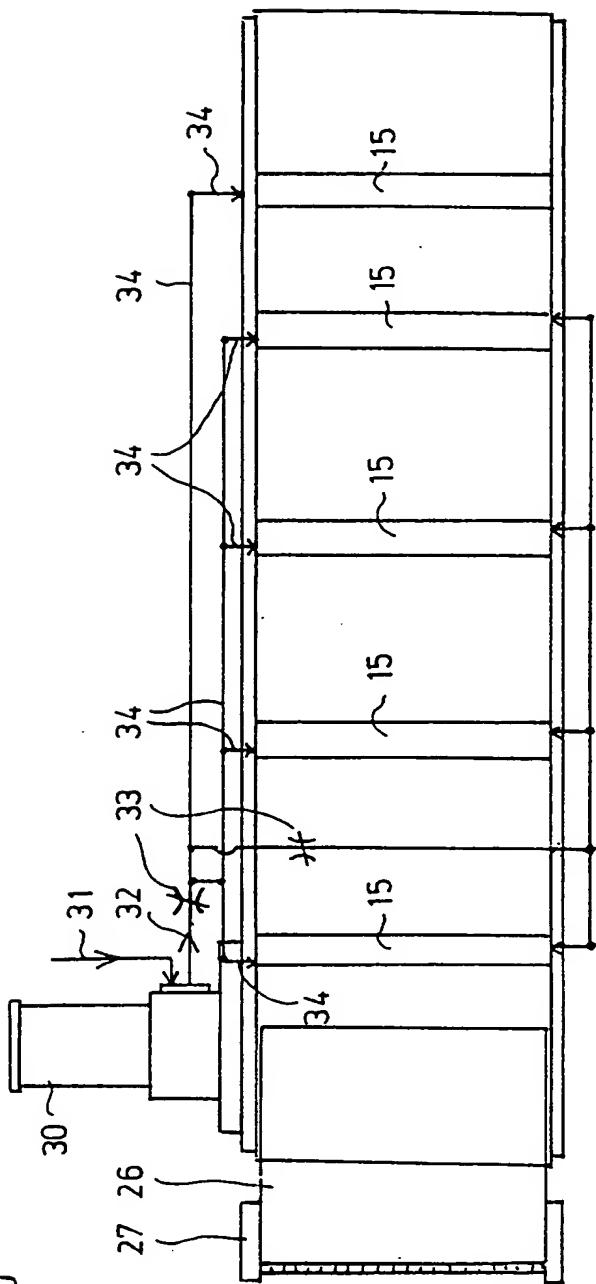
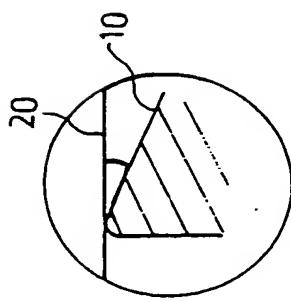


FIG. 2C

FIG. 2B

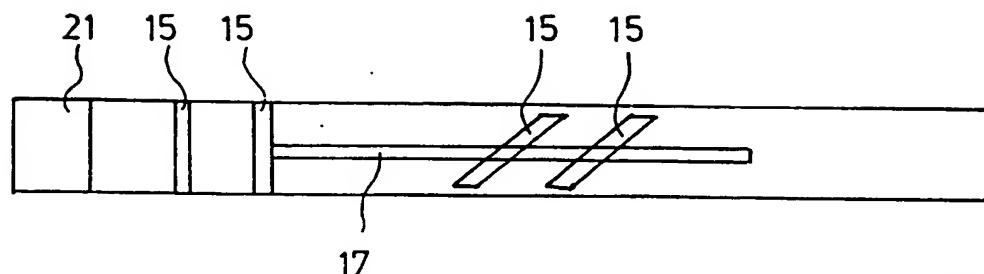


FIG. 3 A

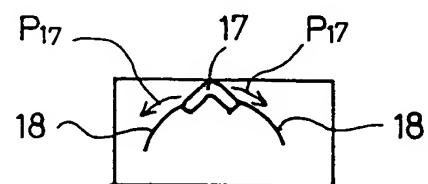


FIG. 3 B

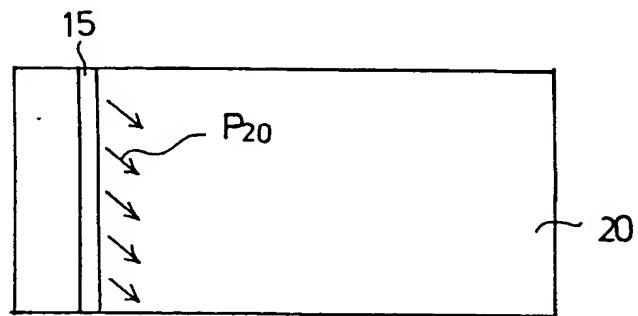


FIG. 4

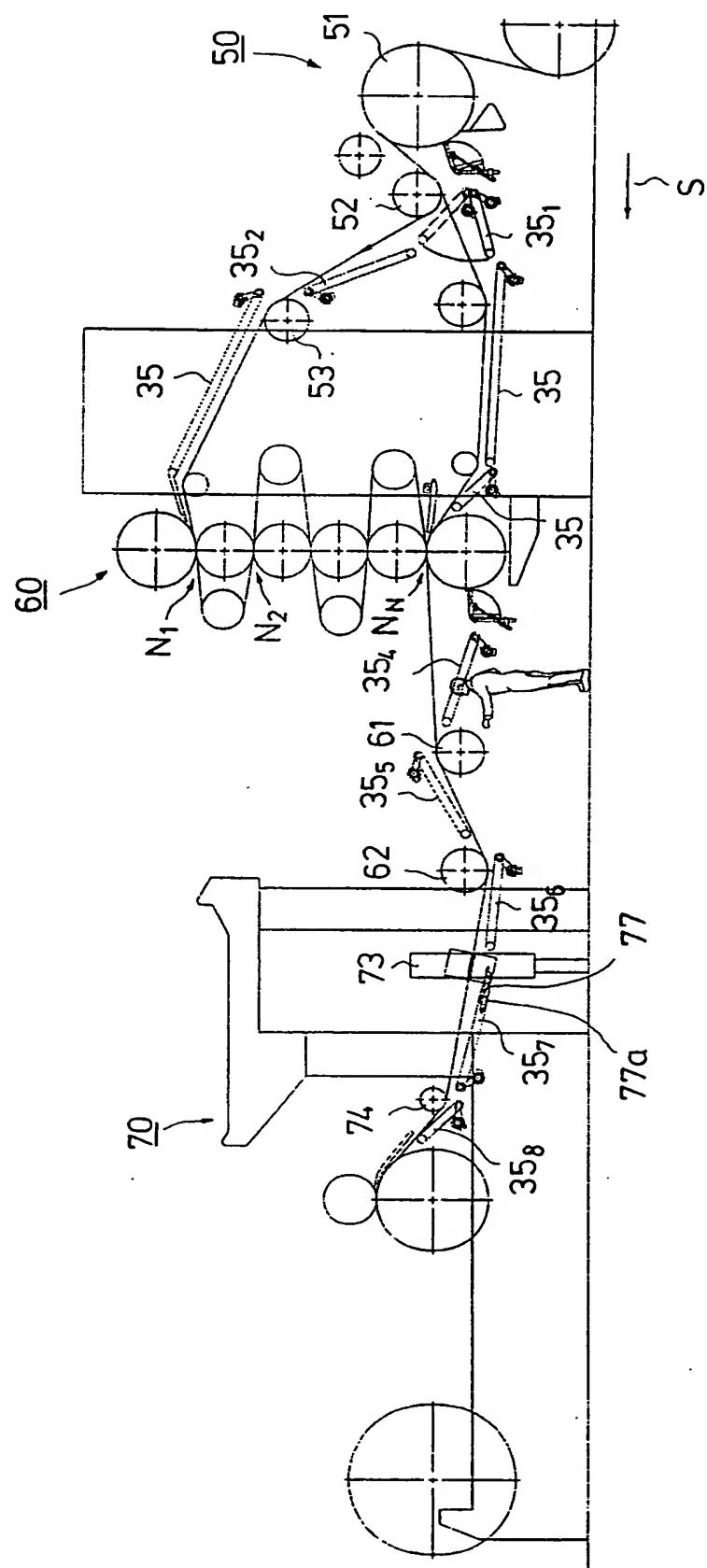


FIG. 5

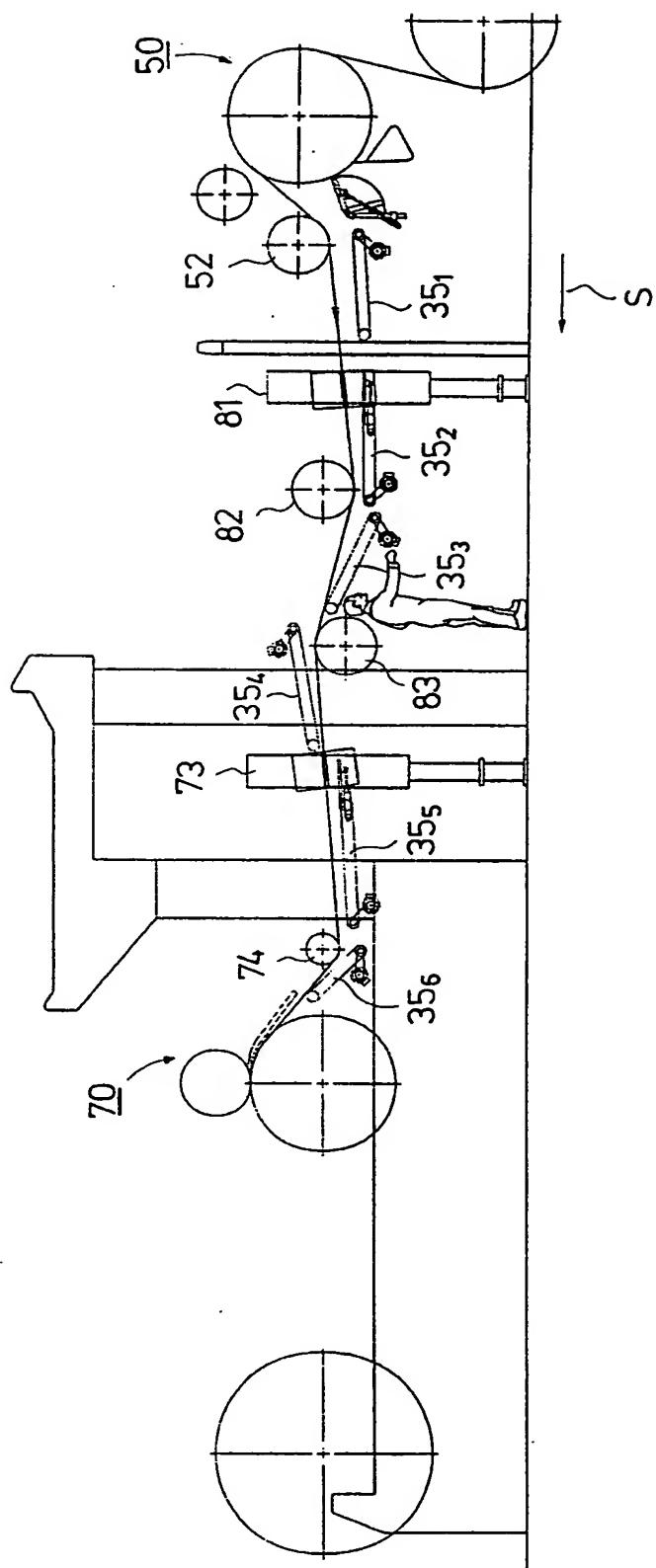


FIG. 6

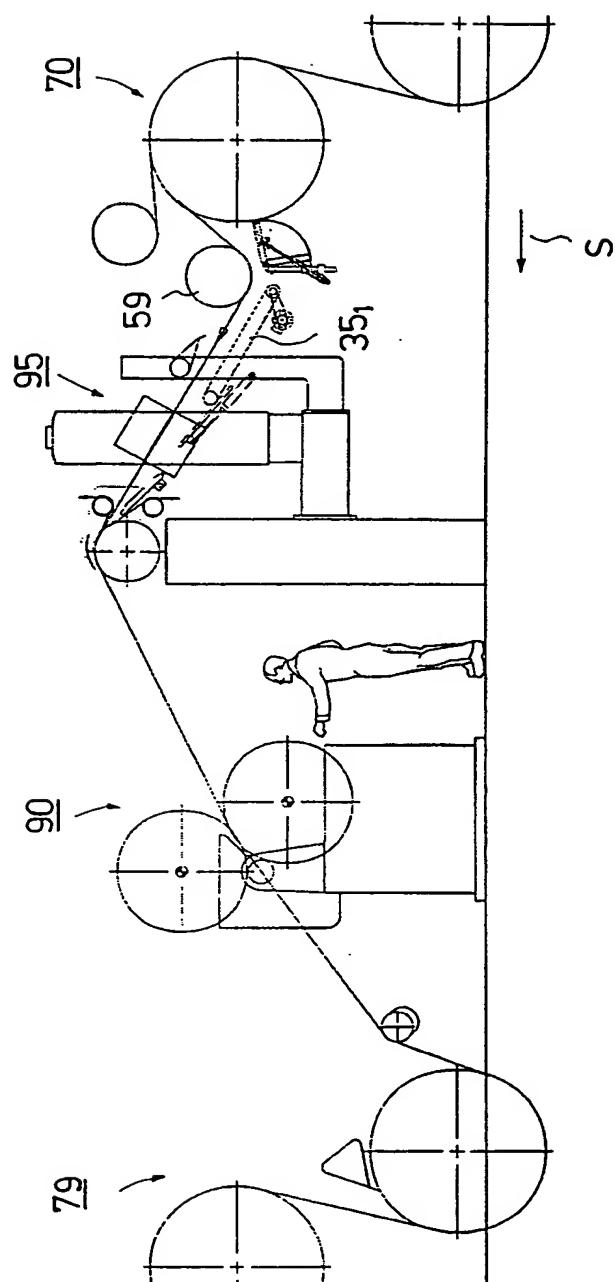


FIG. 7

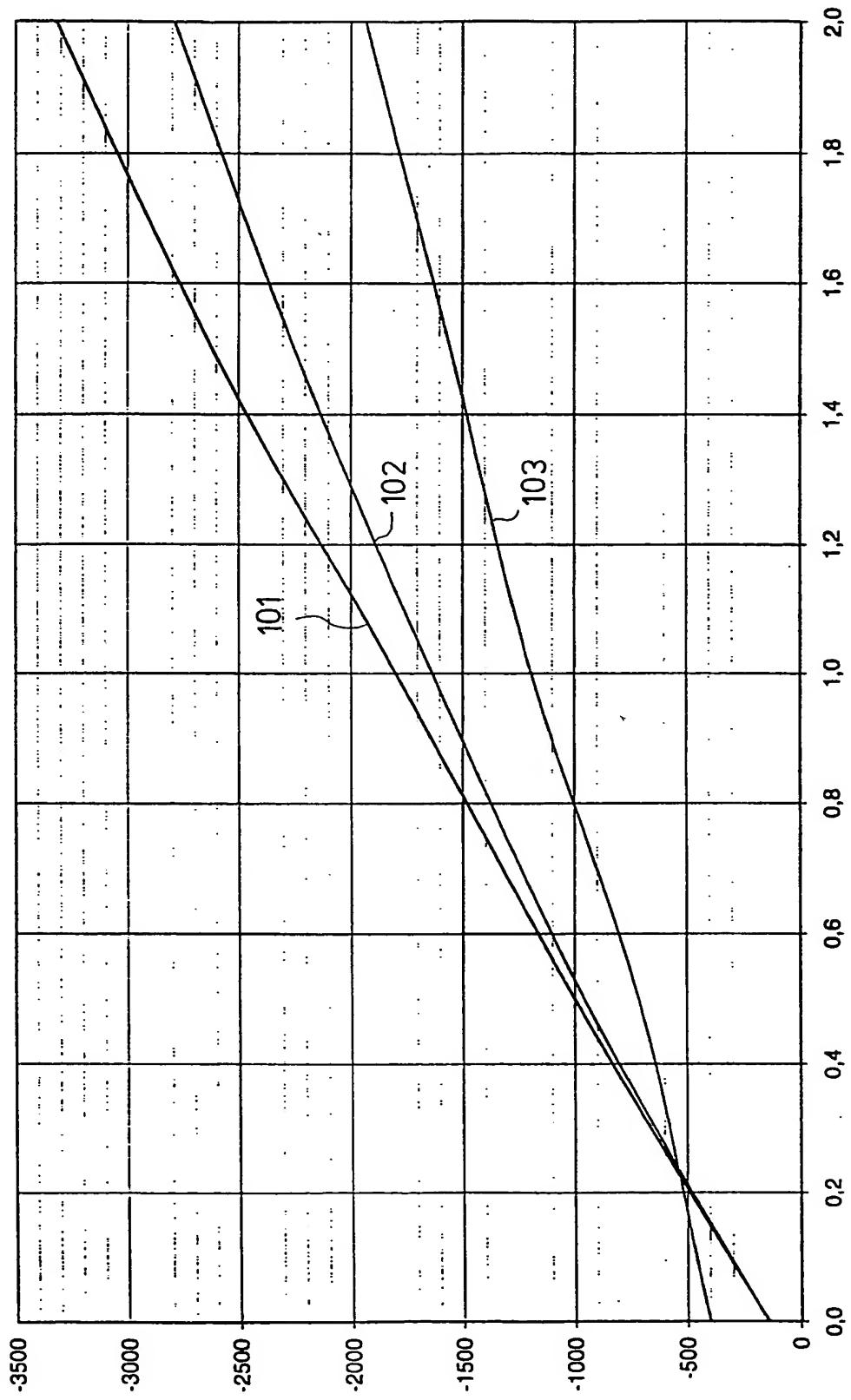


FIG. 8

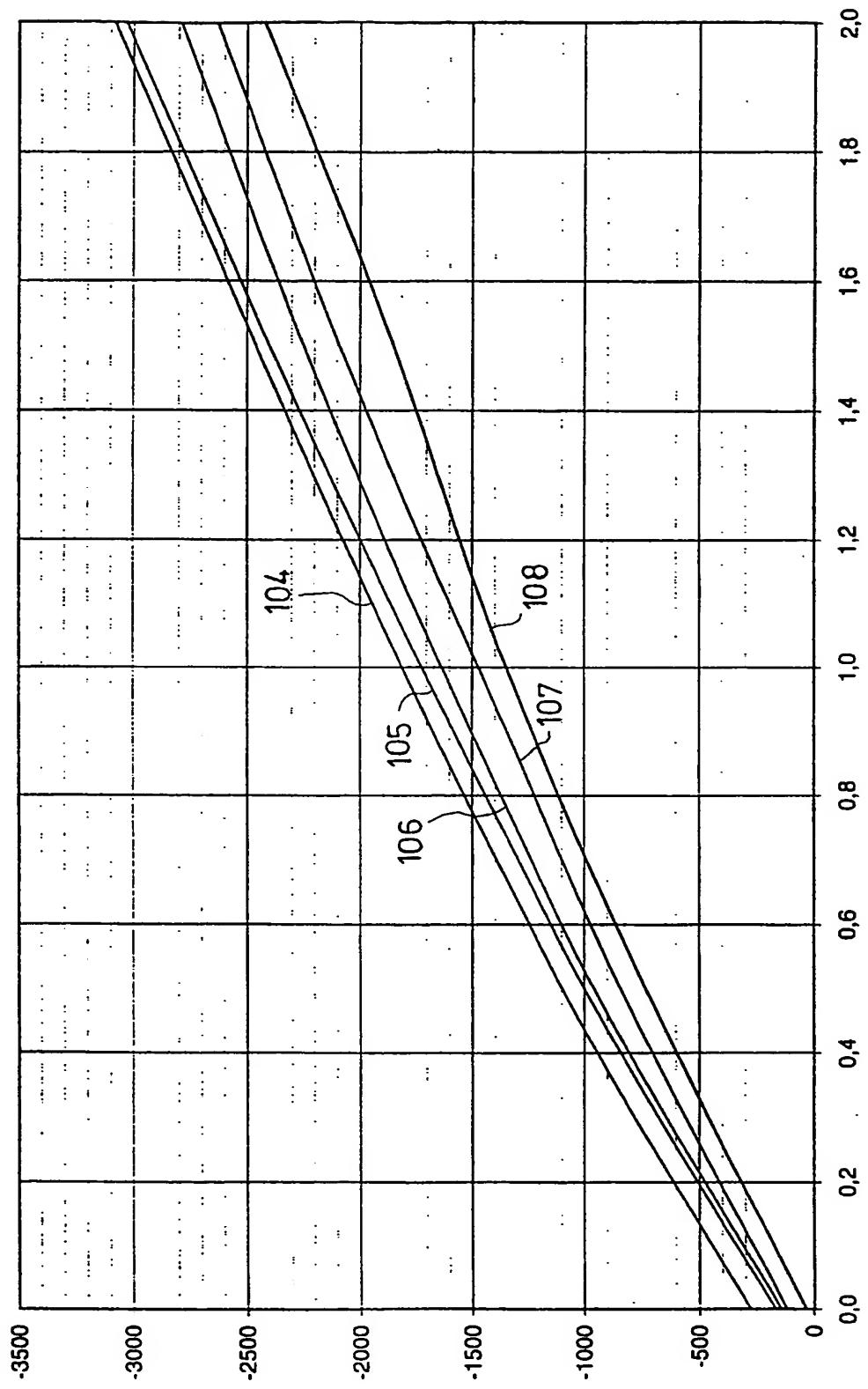


FIG. 9

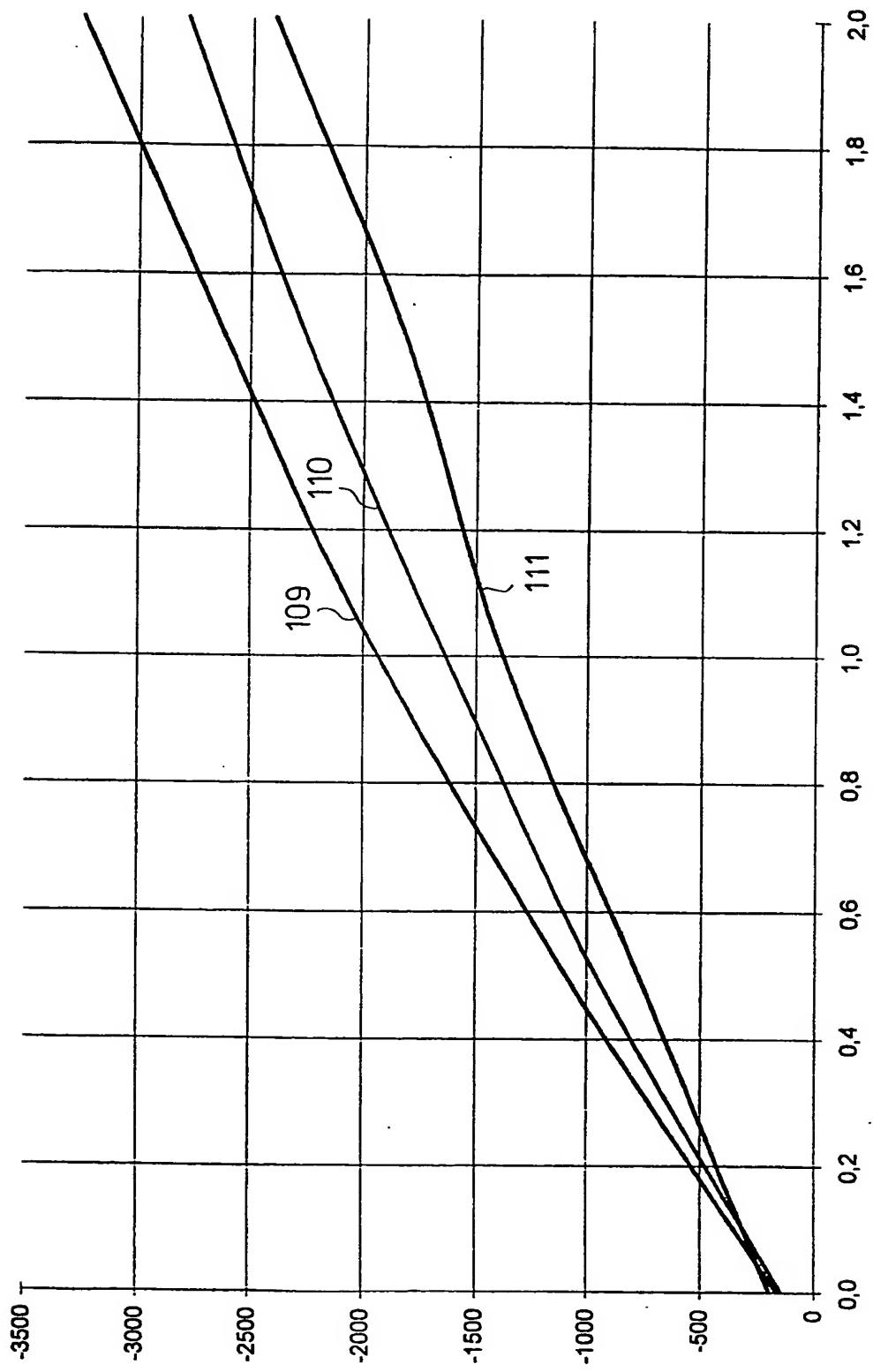


FIG. 10

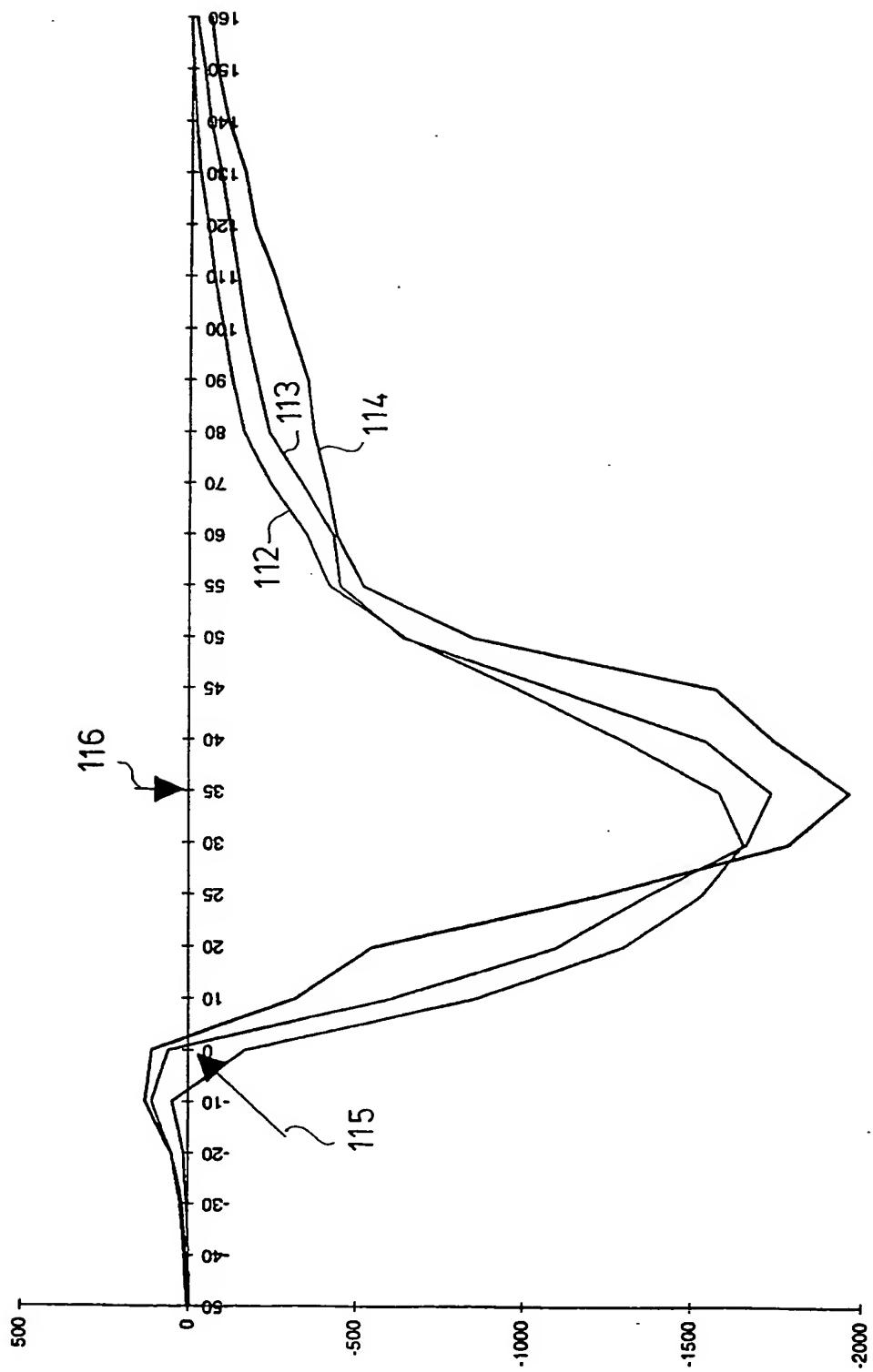


FIG. 11

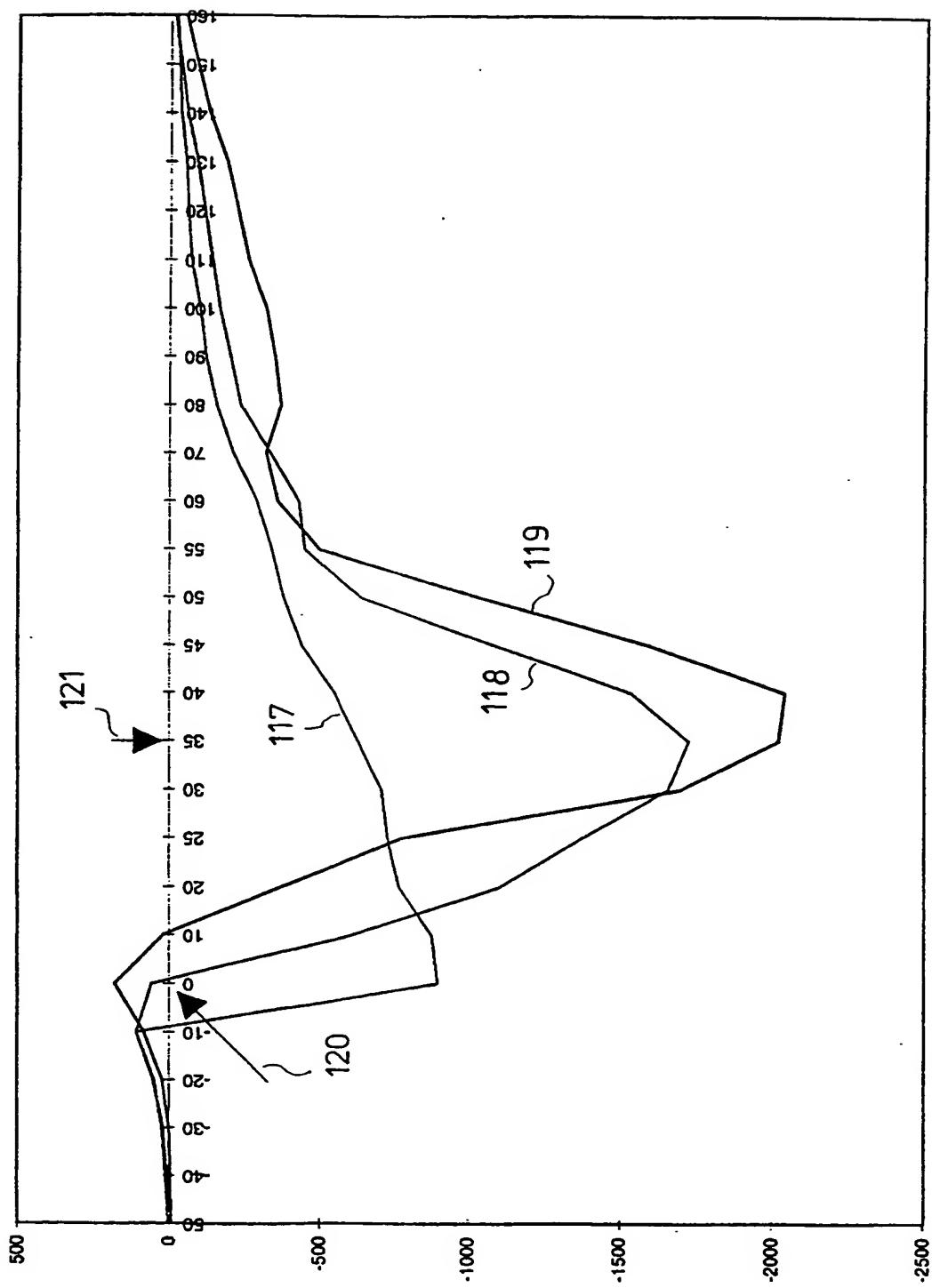


FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 99/00795

A. CLASSIFICATION OF SUBJECT MATTER**IPC7: D21F 7/00**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG: ALLSCIENCE**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4815220 A (G.L. WEDEL), 28 March 1989 (28.03.89), column 2, line 57 - line 59; column 7, line 3 - line 23, figures 5-7	1-3
A	----- -----	4-17

 Further documents are listed in the continuation of Box C. See patent family annex.

- * Special categories of cited documents
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

17 December 1999

Date of mailing of the international search report

04-01-2000

Name and mailing address of the ISA
Swedish Patent Office
Box 5055, S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86Authorized officer
Olov Jensén / MR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/12/99

International application No.

PCT/FI 99/00795

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